Seattle City Light

EVALUATING ENVIRONMENTAL IMPACTS IN THE IRP

2014 IRP STAKEHOLDERS

APRIL 10, 2014

Resource Planning, Forecasting, & Analysis

Agenda

- Introduction
- Overview of Environmental Analyses
- Public Policy
- Climate Change
- EIS
- Emissions
- Risk
- Avoided Costs of Conservation
- Generation Resources
- Key Points From 2014 IRP Update Meetings

Status

- Four Meetings
  - IRP Process and Demand Outlook (June 13, 2013)
  - Power Resources/Conservation (September 12, 2013)
  - Assessing Future Resource Need (January 16, 2014)
  - Environment (April 10, 2014)

Evaluating Environmental Impacts in the IRP: Overview

"When we try to pick anything by itself, we find it hitched to everything else in the universe"
- John Muir

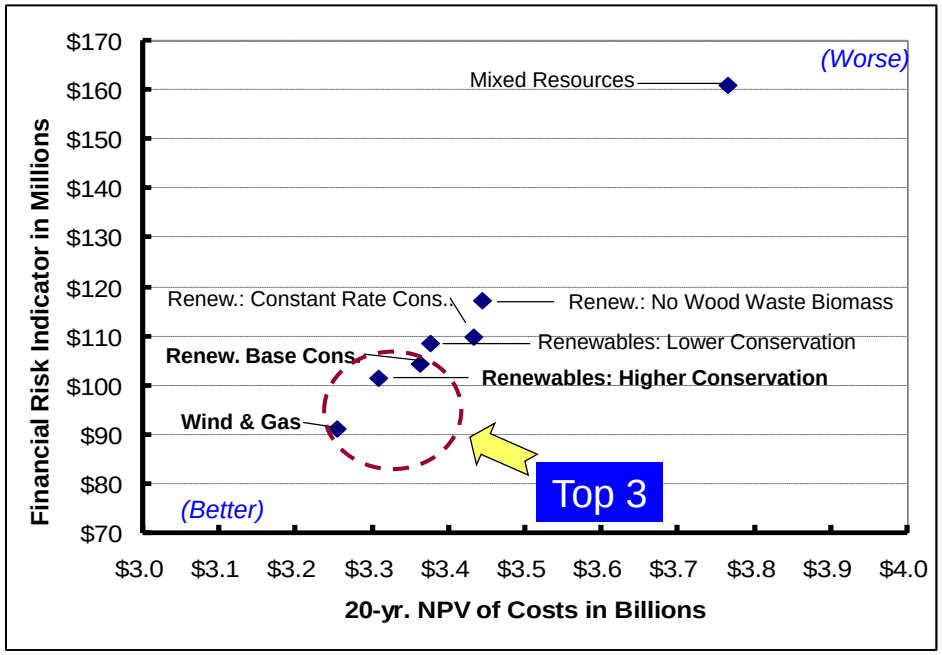
- Qualitative
  - Environmental Impact Statement (EIS)
  - Public Input/Public Policy
  - Generating Resource Characteristics

Environmental Impacts in the IRP: Overview (Continued)

- Quantitative Analysis
  - Carbon costs
    - Forecast
  - Climate change
    - Potential hydro operations impacts
  - Renewable energy credits
  - Air emissions
    - Control costs
  - Risk of insufficient hydro
    - Emissions costs attributed to varying market purchases
  - Conservation avoided cost
    - Environmental costs avoided by conservation

Public Input/Policy

Policy/Law	Energy Efficiency	Renewable Resources	CO2 Offsets	Climate Change
Resolution 31352	X			
Resolution 30144	X	X	X	X
RCW 19.285	X	X		X
RCW 80.60		X		X
RCW 82.16		X		
NPCC	X			
WGA Resolution 06-10	X	X		X
EPACT 2005	X	X		X



Note: Natural gas portfolio was eliminated because of clear inconsistency with Council resolution 30144

Seattle City Light

Integrated Resource Plan: Climate Change

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Overview: Climate Change in the 2010 and 2012 IRPs

2010 IRP

- Changes in climate projected for Washington State
- Impacts on power generation at the Skagit Hydroelectric Project
- Impacts on power generation at the Boundary Hydroelectric Project

2012 IRP

- Impacts on energy demand (load)
- Impacts of glacial retreat on streamflow in the Skagit basin (need identified)

Looking forward to 2016…

Projected Changes in Climate in Washington

Annual Temperature Change (deg. F)

	mean	range
2020s	+2.0	+1.1 to 3.4
2040s	+3.2	+1.6 to 5.2
2080s	+5.3	+2.8 to 9.7

Extremes: more frequent heat waves

Annual Precipitation Change (Percent)

	mean	range
2020s	1%	-9 to +12%
2040s	2%	-11 to +12%
2080s	4%	-10 to +20%

Extremes: more frequent intense precipitation events

Washington State Snowpack (Percent Change)

	High (A1B)	Low (B1)
2020s	-29%	-27%
2040s	-44%	-37%
2080s	-65%	-53%

A1B is a scenario of high emissions and warming. B1 is a low scenario of emissions and warming.

*Climate change projections used in 2010 and 2012 IRP

Methods for climate change analysis

Skagit Hydroelectric Project

- Projections of climate and streamflow from the Climate Impacts Group, UW
- Skagit operations model - optimizes flows and reservoir levels for recreation, flood control, and instream flows for fish protection.
- Two climate scenarios (A1B, B1) and three future time periods (2020s, 2040s, 2080s)

Boundary Hydroelectric Project

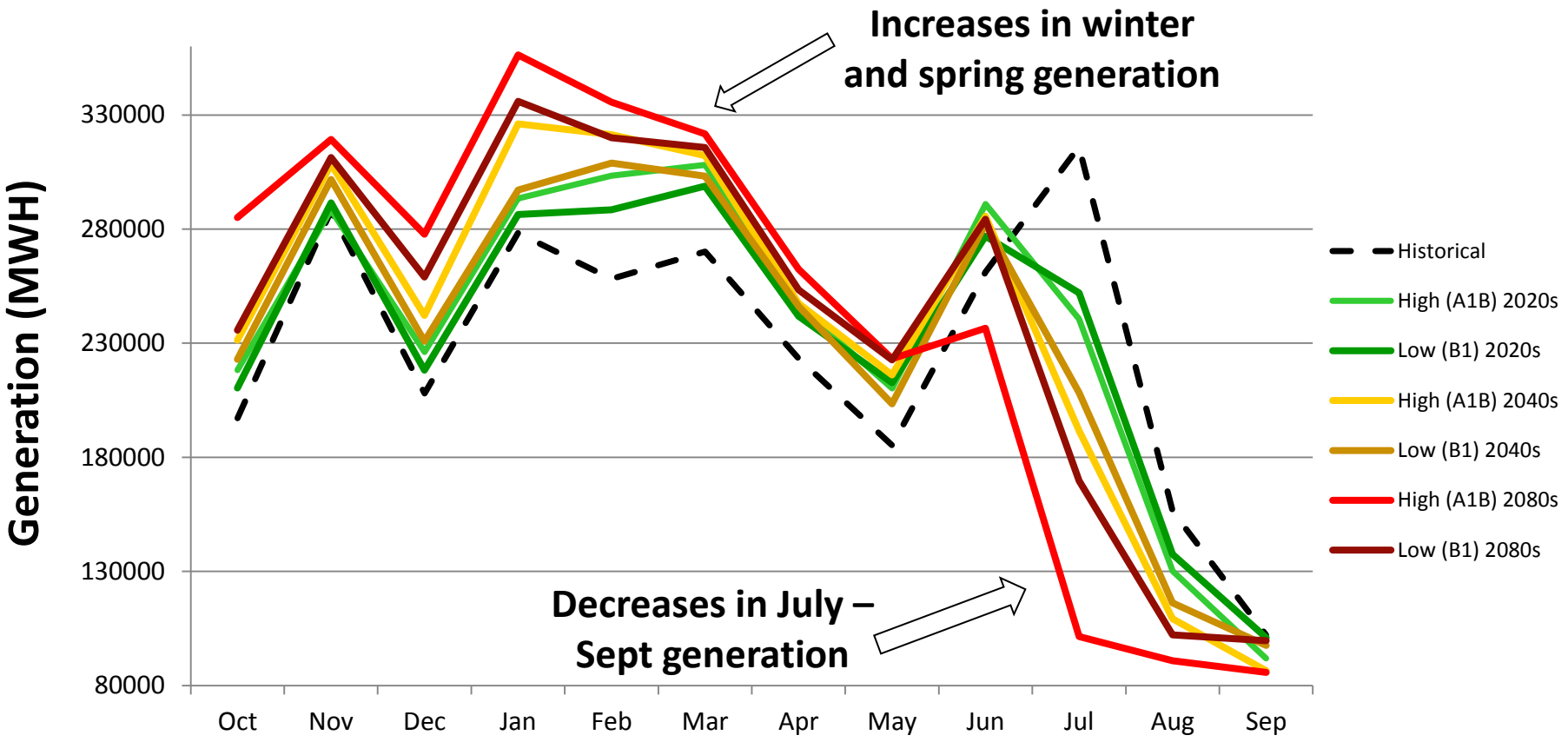
- Projections of climate and streamflow from the Climate Impacts Group, UW
- Northwest Power and Conservation Council's Sixth Power Plan Assessment
- One climate scenario (A1B) and one future time period (2040s)

Climate Change Modeling Assumptions

Climate Change Modeling for the IRP is not a Forecast

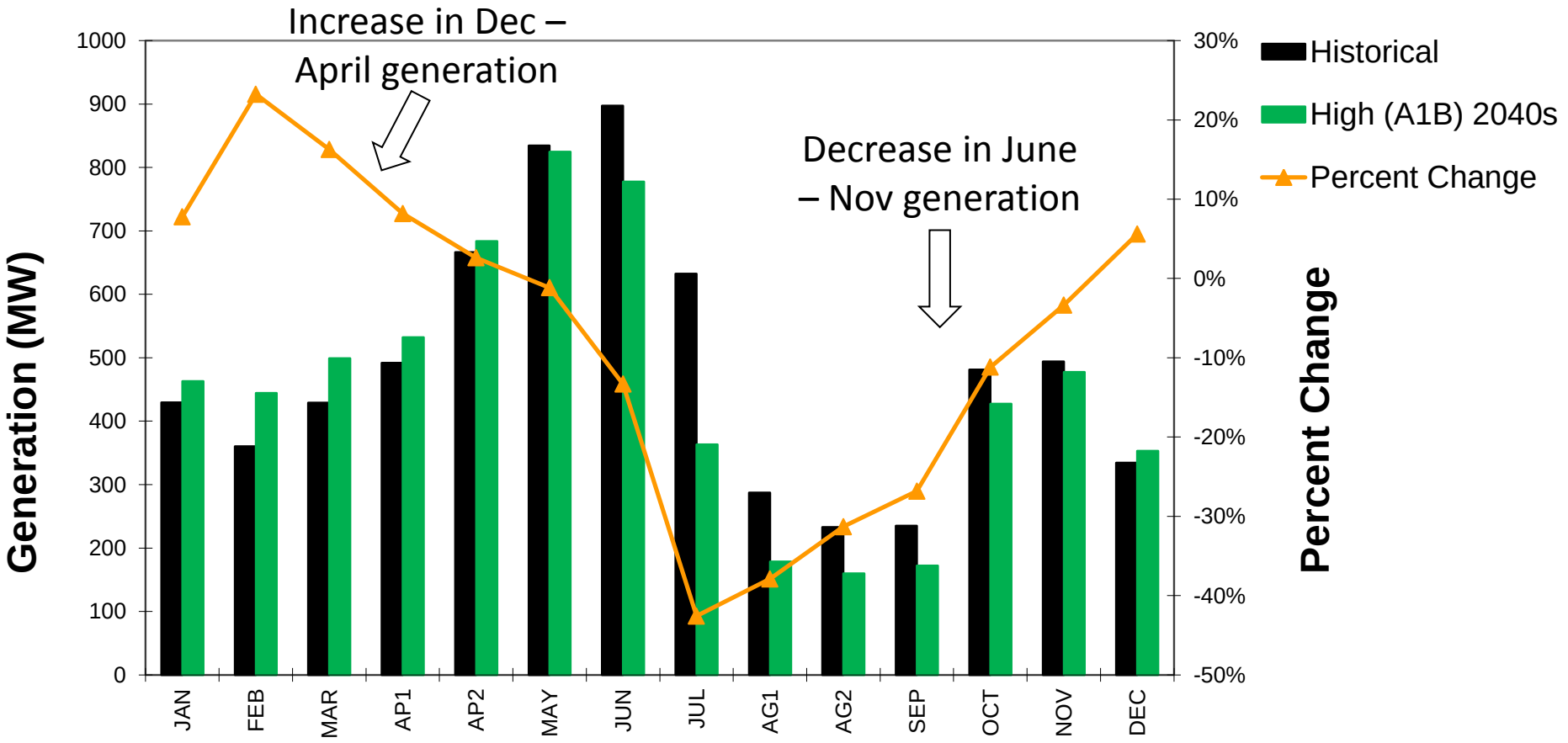
- Indicative of expected general trends in streamflow and generation
  - The analysis was based on a reservoir operations model with *simplified constraints*
  - Assumed *no changes* in operating constraints
    - » Flood control curves
    - » Instream flows for fish protection
    - » Operations of hydroelectric projects upstream of the Boundary project
  - Did not include changes in glacier runoff and tributary streamflows in the Skagit basin

Climate change and Power Generation: Skagit Project



*Assumes no changes in external reservoir operating constraints

Climate change and Power Generation: Boundary Project



*Assumes no change in flood control curves and upstream operations of projects.

Climate Change Impacts on Energy Demand in Seattle

Small *increases* in energy demand in July and August and decreases in energy demand in all other months.

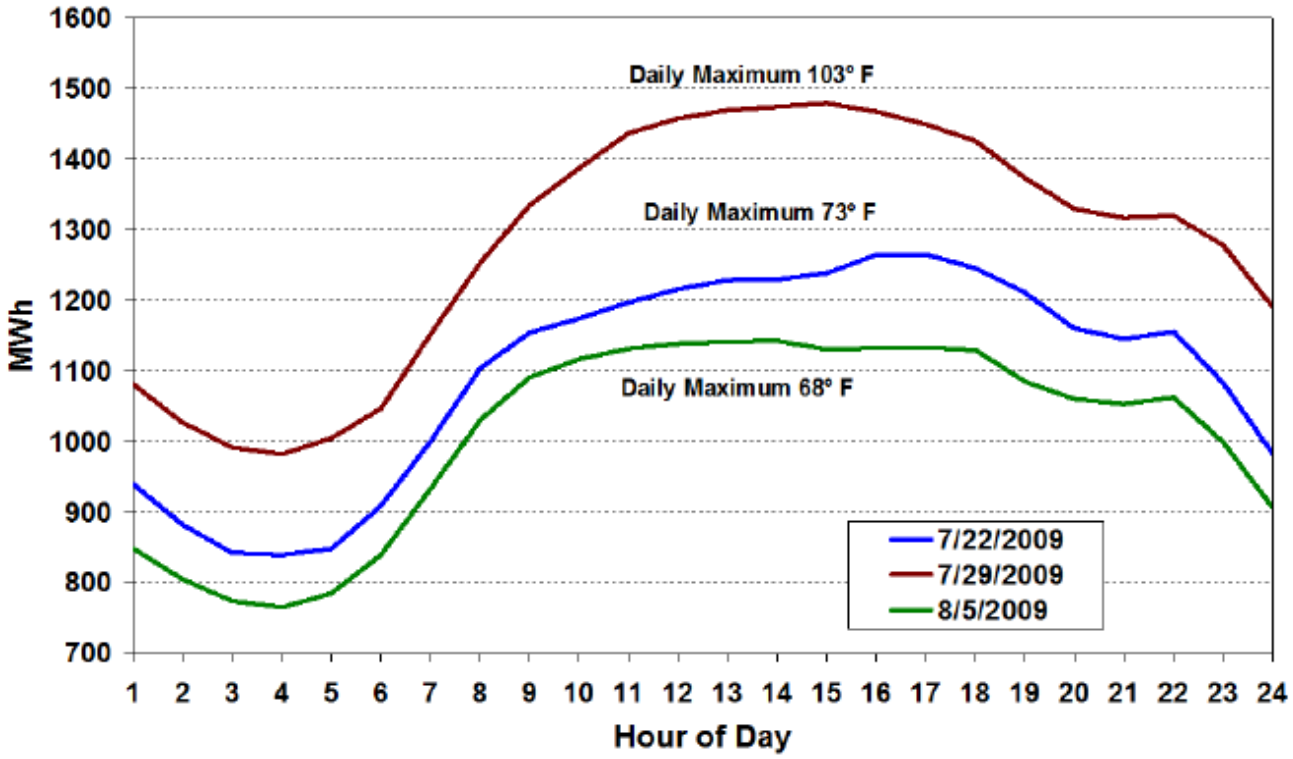
Changes in energy demand (aMW)

Season	Mean	Range
May – Oct	-2.8	-0.6 to -5.2
July – Aug	+4.8	+2.4 to +7.1
Nov – Apr	-27.6	-26.4 to -28.7

- Average decrease of 0.6 aMW per year
- Average City Light load is about 1100 aMW per year
- Long-term growth in load is projected to be 6.6 aMW per year

Climate Change Impacts on Energy Demand – Extreme Heat

Peak events (extreme hot days) can greatly increase energy demand.



*The frequency of extreme hot days and heat waves is expected to increase.

Continued Research and Planning for Climate Change

Climate Change Initiative – 2012 Strategic Plan

1. Climate Change Research

Support research to assess the long-term climate change risks to watersheds, energy generation, energy delivery, and other infrastructure.

2. Adaptation Planning

Develop strategies to prepare for climate change impacts and reduce the adverse effects.

Current Climate Change Research: Glaciers

Glaciers in the North Cascades are retreating at an increasing rate.

Glaciers contribute significant water in summer to the Skagit River below Ross lake (up to 44%) and smaller amount above the lake (7%).

Current Research

- Improved inventory of glacier area and glacial recession (NPS)
- Model current glacier runoff contributions to streamflow (NPS and UW)
- Model future changes in glacier runoff with climate change (UW)

Future Research and Planning

Update assessment of climate impacts on power generation at the Skagit and Boundary projects.

- Next generation of climate models and climate scenarios
- Incorporate changes in glacier runoff
- More realistic reservoir operating constraints

Continue to monitor responses of other agencies to climate change

- Bonneville Power Administration: 2014-2017 climate change study
- BC Hydro
- Army Corps of Engineers: flood control regulations
- Department of Ecology: fish protection and instream flow regulations

Questions?

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EIS - Environmental Impact Statement

Today

- Review and summarize the 2012 EIS, and our plans for the 2016 EIS.
- We expect the 2012 EIS will not need much modification.
- If we find that changes are needed we will consider adding an appendix or an update to this existing document.
- We will review and evaluate environmental risk for any SCL resource acquisitions, including RECs

SCL's Environmental Policy

- SCL is committed to high standards of environmental protection.
- City of Seattle and City Light environmental policies call for City Light to:
  - avoid, minimize, or mitigate impacts to the ecosystems that it affects,
  - and to incorporate environmental costs, risks, and impacts when making decisions.
- SCL's Environmental Policy Statement is included in Appendix B of the 2012 EIS.

EIS

- The 2012 EIS assessed environmental impacts and mitigation options by individual electric resource, and then by portfolio.
- Operation and construction impacts, and mitigation options were assessed for each resource type.

Impacts by Resource Type
EIS Appendix C

Appendix C first describes each energy resource and then ten elements of the environment:

(1) Soils and Geology, (2) Air Quality, (3) Surface and Groundwater, (4) Plants and Animals, (5) Energy and Natural Resources, (6) Environmental Health, (7) Land Use; (8) Aesthetics and Recreation, (9) Historic and Cultural Resources, and (10) Employment.

- Each element of the environment has a section in Appendix C
  - General environmental impacts that have the potential to occur for nearly every resource.
  - Impacts for each electric resource and potential mitigation options.

Table 1-4. Summary of Resource Impacts

Elements of the Environment	Energy Resources										
	Conservation	Landfill Gas	Gorge 2nd Tunnel	Geothermal	Biomass (Cogen)	Wind	Solar Energy (Utility-Scale)	Natural Gas (CCCT)	RECs	Market Transactions	Transmission
Soils and Geology											
Construction	L	L	M	M	L	M	H	M	L - H	L	M
Operation	L	L	L	M	L	L	L	H	L - M	H	L
Air Quality											
Construction(NOx, SOx, PM, Hg)	L	L	L	L	L	L	L	L	L	L	L
Operation(NOx, SOx, PM, Hg)	L	L	L	L	M	L	L	M	L-M	M	L
Construction (CO_2)	L	L	L	L	L	L	L	L	L	L	L
Operation (CO_2)	L	L	L	L	L	L	L	H	L	H	L
Surface and Groundwater											
Construction	L	L	L	L	L	L	L	L	L	L	M
Operation	L	L	L	M	M	L	M	H	L-M	H	M
Plants and Animals											
Construction	L	L	L	H	L	M	M	M	L-H	L	M
Operation	L	L	L	L	L	M	M	M	L-M	M	M
Energy and Natural Resources											
Construction	L	L	L	L	L	L	L	L	L	L	L
Operation	+L	+L	+L	+L	+L	+L	+L	H	+L	H	M
Environmental Health											
Construction	L	L	L	M	M	M	L	M	L-M	L	H
Operation	L	L	L	M	M	M	L	M	L-M	M	M
Land Use											
Construction	L	L	L	M	M	M	M	M	L-M	L	M
Operation	L	L	L	M	L	M	M	M	L-M	M	H
Aesthetics and Recreation											
Construction	L	L	M	M	M	M	M	M	L-M	L	M
Operation	L	L	L	M	M	H	H	M	L-H	M	H
Historic and Cultural Resources											
Construction	L	L	L	M	M	M	M	M	L-M	L	M
Operation	L	L	L	L	L	H	H	M	L-M	M	H
Employment											
Construction	+H	+L	+L	+L	+L	+L	+H	+L	+L-+H	+L	+L
Operation	+L	+H	+L	+M	+M	+L	+M	+L	+L-+H	+L	+L

LEGEND

L	Low Impact		M	Moderate Impact		H	High Impact		+L, +M, +H	Positive Impact

Impacts by Resource Portfolio

- Chapter 3 of the EIS describes the environmental impacts of the four resource portfolio scenarios.

- Impacts and mitigation are discussed for each scenario under each environmental element

Table 1-5. Summary of Portfolio Impacts

Elements of the Environment	1. Rely on Market	2. Renewables: Base Conservation	4. Renewables: Higher Conservation	5. Wind and Gas
Soils and Geology				
Construction	L	M	M	M
Operation		L	L	H
Air Quality				
Construction(NOx, SOx, PM, Hg)	L	L	L	L
Operation(NOx, SOx, PM, Hg)	M	M	M	M
Construction (CO_2)	L	L	L	L
Operation (CO_2)	H	M	M	H
Surface and Groundwater				
Construction	L	L	L	L
Operation	H	L	L	H
Plants and Animals				
Construction	L	M	M	M
Operation	M	M	M	M
Energy and Natural Resources				
Construction	L	L	L	L
Operation	H	L	L	M
Environmental Health				
Construction	L	M	M	M
Operation	M	M	M	M
Land Use				
Construction	L	M	M	M
Operation	M	M	M	M
Aesthetics and Recreation				
Construction	L	M	M	M
Operation	M	M	M	M
Historic and Cultural Resources				
Construction	L	M	M	M
Operation	M	M	M	M
Employment				
Construction	+L	+M	+M	+M
Operation	+L	+L	+L	+L

LEGEND

L	Low Impact		M	Moderate Impact		H	High Impact		+L, +M, +H	Positive Impact

IRP Environmental Impact Statement

- We don’t anticipate much change to the EIS unless we get new information
- Reasons for an update might include new evaluation criteria, a change in emissions information, or updates to regulations.
- We may get new information on biomass
- We will review and evaluate environmental risk for any SCL resource acquisitions, including RECs

Thank you

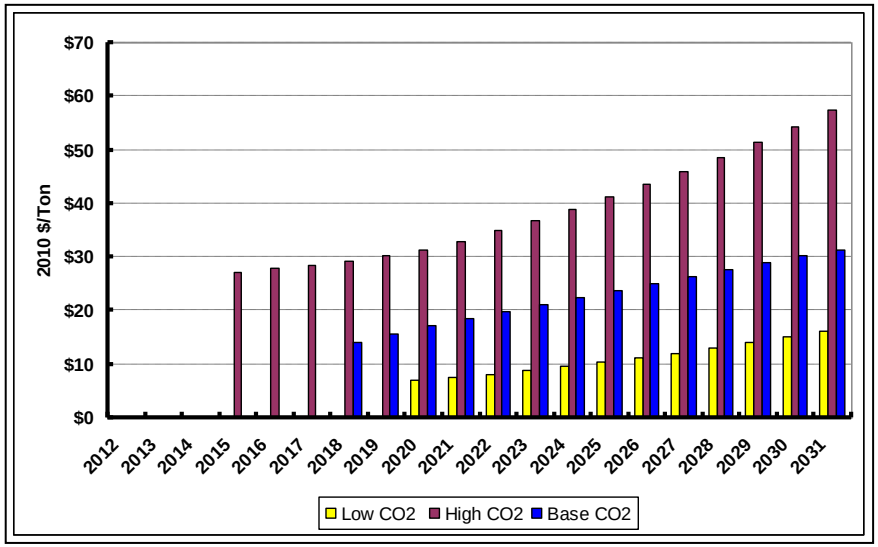
Thanks to Corrine for putting this together.

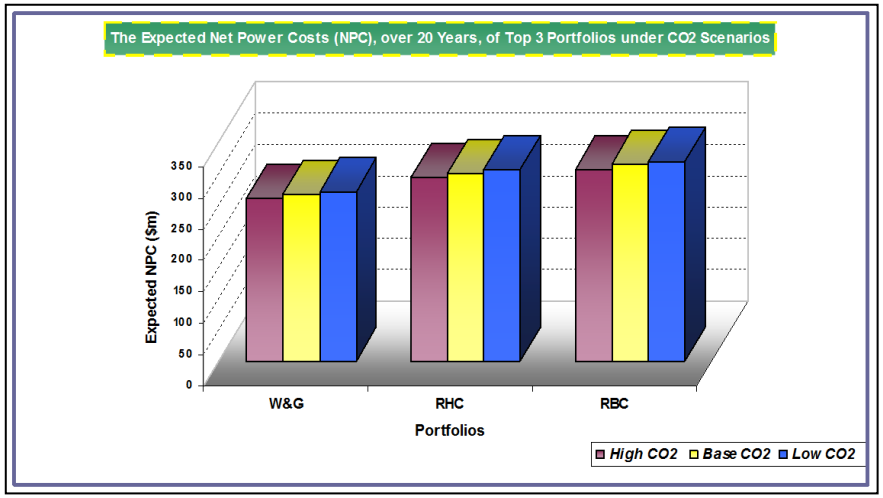
Emissions By Energy Resource

Resource	Carbon Dioxide	Nitrogen Oxide	Sulfur Dioxide	Mercury	Particulate
Hydro	0	0	0	0	0
Conservation	0	0	0	0	0
Landfill Gas	0	0.66	0	0	0.107
Waste Wood Biomass	0	2.218	0.4265	0	0.3412
Hydro Efficiency	0	0	0	0	0
Wind	0	0	0	0	0
Geothermal	0	0	0	0	0
Solar PV	0	0	0	0	0
Solar Thermal	0	0	0	0	0
Combined-Cycle Turbine	857	0.216	0.00432	0	0.005

Levelized Emissions Price	2012 $/lb.
Carbon Dioxide	$0.01
Nitrogen Oxide	$0.98
Sulfur Oxides	$1.09
Mercury	$3.60
Particulates	$1.94

CO_2 Emissions Cost Scenarios for Top Resource Portfolios

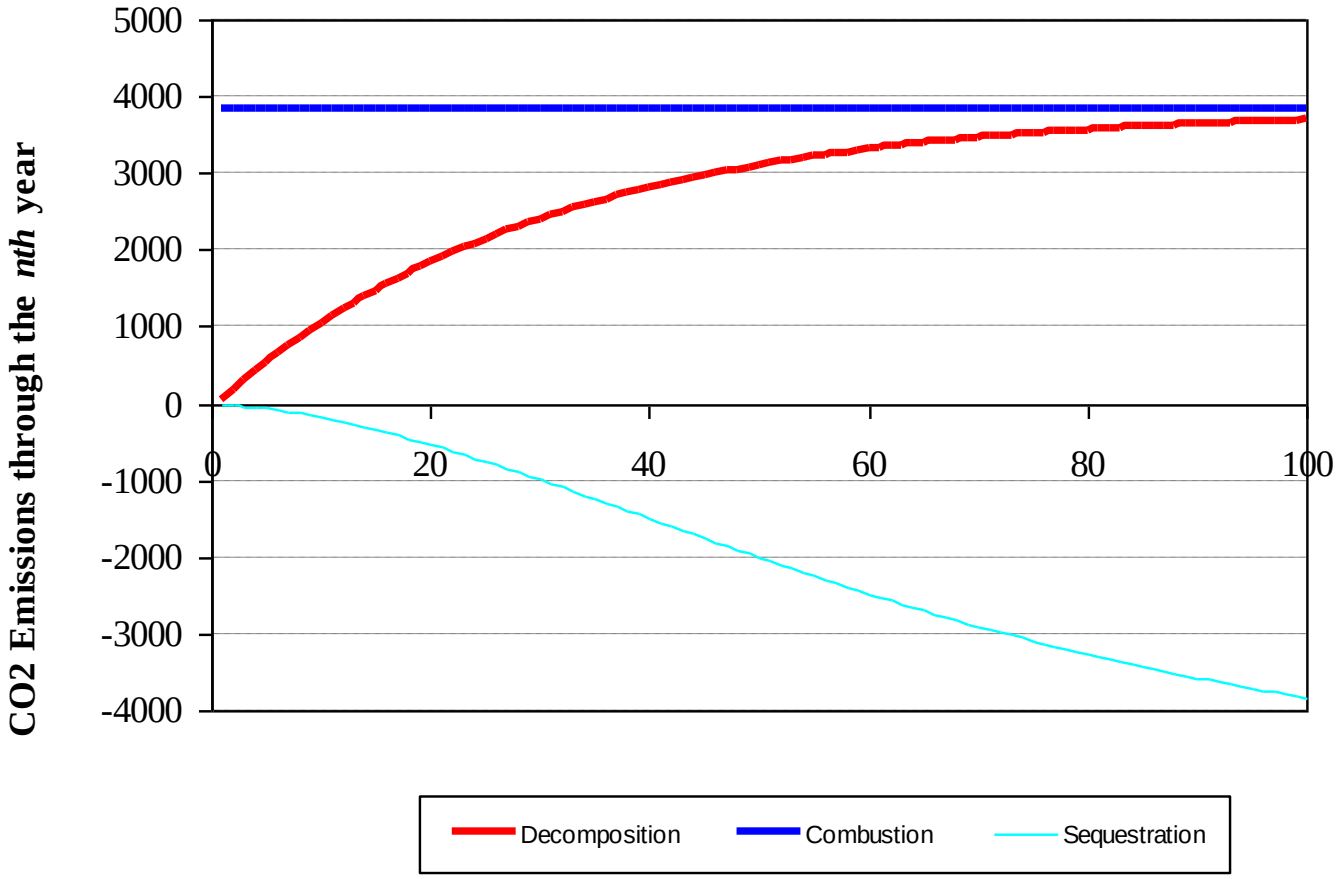




Biomass CO_2 Emissions Framework

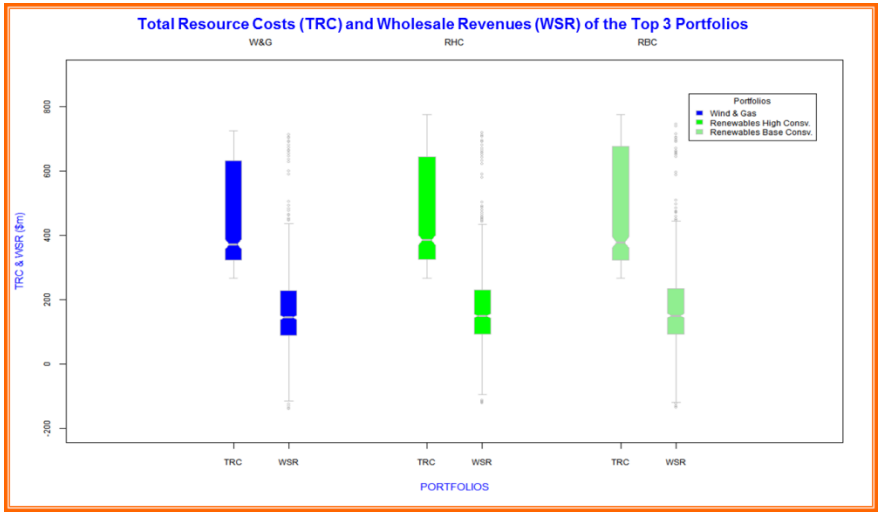
- Framework Considers:
  - The time value of CO_2 emissions
  - The time value of CO_2 sequestration
  - Other fates of wood waste
    - Besides fuel for electricity generation, wood waste can decompose and/or be burned for disposal (e.g. burning slash)
  - Differing values for timing and percent of wood waste burned versus decomposing

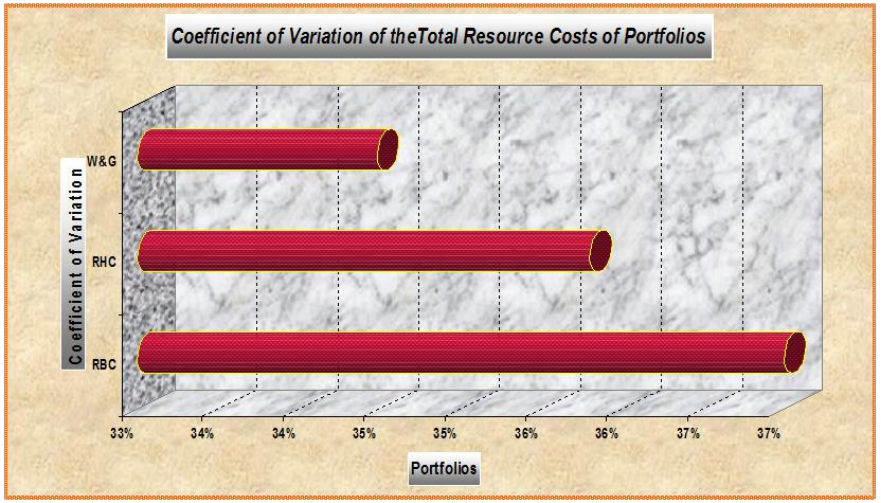
Cumulative Emissions of Sources Combustion, Decomposition, and Sequestration



Risk

- Risk evaluated in detail for the top 3 performing portfolios
  - Includes calculations for environmental costs





Three Alternative Avoided Cost Forecasts for Conservation

Levelized $2012/MWh	1) Market Price	2) Market Price Plus 2021 CCT	3) 2013 IRP Preferred Portfolio
Market Price Outlook	$31.99		
+ 2021 CCT		$46.94	
2012 Preferred Portfolio			$61.39
Adders*	$19.92	$21.42	$16.66
Total	$51.91	$68.36	$78.05
% Higher From #1	0%	32%	50%

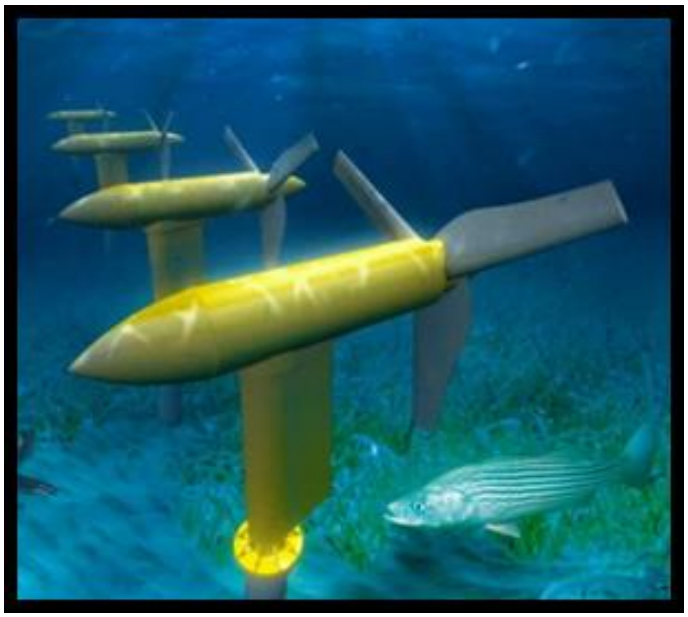
(Used by SCL)

Why the 2012 IRP Avoided Costs are Lower than 2010 Avoided Costs

- New Resources Enter the 2012 Portfolio Six Years Later With Change to 10% LOLP From 5% LOLP
  - Less resources avoided by conservation in 2012 IRP
- Market Prices are Lower than 2010

	Marginal Resource	
	2010 IRP	2012 IRP
2015	LFG	
2016	BIO	
2017	HYDRO	
2018	HYDRO	
2019	GEO	
2020	WIND	LFG
2021	WIND	LFG
2022	WIND	BIO
2023	WIND	WIND
2024	WIND	WIND
2025	WIND	WIND
2026	WIND	WIND
2027	WIND	WIND
2028	WIND	WIND
2029	WIND	WIND
2030	WIND	WIND
2031	WIND	WIND
2032	WIND	PV

- Generation Resources
  - Investigating New Clean Technologies
    - Solar
    - Tidal & Wave Energy
    - Fuel Cells/Bloom Box



Key Points

- 2014 IRP Update Meetings
  - IRP Process and Demand Outlook (June 13, 2013)
    - Public participation a requirement and a challenge
    - Demand forecast fell in 2012 and 2013 despite economic recovery
  - Power Resources/Conservation (September 12, 2013)
    - Major decline in natural gas prices and steady decline in solar prices
    - Regional wind and hydro generation coincidence and negative pricing
    - Uncertain emissions regulations and WECC coal plant retirements
    - Low market prices make carrying unneeded renewables very costly
    - 2013 cost-effective conservation potential similar to previous CPAs

Key Points (Continued)

- Assessing Future Resource Need (January 16, 2014)
  - Eye of the beholder: the appropriate resource strategy differs from a cost, risk, reliability, or environmental impact point of view
  - A 90% resource adequacy target (10% LOLP) means some reliance upon the market under adverse conditions (changed for 2012 IRP)
  - WECC and the NPCC offer different views of the state of the market

- Environment (April 10, 2014)
  - Climate change impacts to hydropower mixed: summer costs and winter benefits
  - Hydropower operational challenges likely to increase
  - Environmental impacts an important IRP portfolio screening criteria

Next Steps

- Summarize Insights from Stakeholder Input and the 2014 IRP Update Process
- Brief Council Energy & Environment Committee
- Complete Writing the IRP Update
- IRP Stakeholder Letter to City Council
- Seek City Council Approval
- File Final IRP Update With Washington Dept. of Commerce by September 1

Questions or Comments?

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